



California Environmental Protection Agency  
Department of Pesticide Regulation

# Ambient Air Monitoring for Pesticides in Lompoc, California

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# Agenda

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- Summary (*please hold questions during this part*)
- Background
- Area and Pesticides Monitored
- Methods
- Results
- Conclusions and Recommendations



## Summary

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- In 2000, DPR conducted air monitoring for 31 pesticides and breakdown products in Lompoc
- DPR chose higher risk pesticides for monitoring based on toxicity, volatility, and amount of use
- For most pesticides (except fumigants), DPR collected 24-hr samples, 4 days/week, for 10 weeks, at 4 sites
- To evaluate the data, DPR, DHS, and OEHHA developed health screening levels for each of the pesticides



## Summary, continued

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- The monitoring was designed to answer 3 questions
  - Are residents of Lompoc exposed to pesticides? **Yes, 27 pesticides were detected in one or more samples.**
  - If so, which pesticides and in what amounts? **MITC had the highest measured concentration, 1885 ng/m<sup>3</sup>.**
  - Do measured levels exceed levels of concern to human health? **No, measured levels of the individual and combined pesticides did not exceed health screening levels, but concentrations of some pesticides may be higher during some days or months not monitored.**



## Background

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- Lompoc is located in a coastal valley of Santa Barbara County, California
- Five major crops are grown in the area between the coast and Lompoc: cole crops, lettuce, dried beans, celery, and flowers
- Lompoc is downwind from the agricultural area
- DPR formed the Lompoc Interagency Work Group (LIWG) to help investigate concerns about pesticide use and community health



## Background, continued

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- The LIWG requested that DPR answer 3 questions
  - Are residents of Lompoc exposed to pesticides?
  - If so, which pesticides and in what amounts?
  - Do measured levels exceed levels of concern to human health?
- DPR conducted ambient air monitoring in Lompoc to answer these questions
- DPR consulted with LIWG's Technical Advisory Group throughout the project



# Monitoring Sites

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- All monitoring sites within Lompoc
- Site selection based on
  - Proximity to agricultural areas
  - Wind patterns
  - US EPA siting criteria
  - Electricity
  - Security
  - Permission



## Monitoring Sites, continued

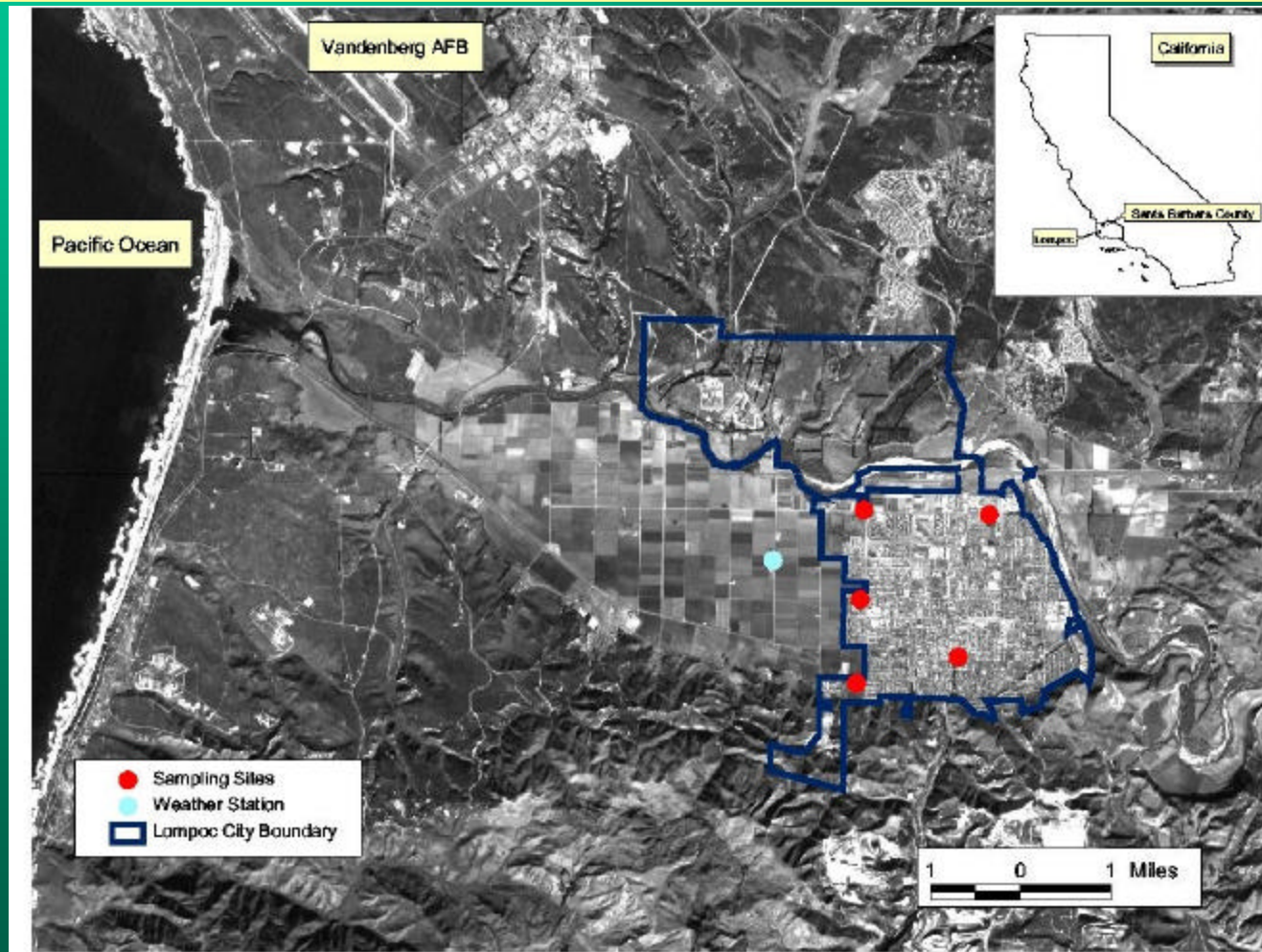
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- Northwest: **Santa Barbara County Animal Control Shelter**  
1501 West Central Ave, at V St
- West: **Clarence Ruth School**  
501 North W St, at College Ave
- Southwest: **Miguelito School**  
1600 West Olive St, at V St
- Central: **Santa Barbara County APCD monitoring trailer**  
Between G and H Streets, ½ block south of Ocean Ave
- Northeast (Fumigants): **Lompoc School District Bus Garage**  
1313 North A St, at Central Ave





# Lompoc Area and Monitoring Sites





## Pesticides Monitored

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- DPR conducted air monitoring for 31 pesticides and breakdown products
- DPR chose higher risk pesticides for monitoring based on toxicity, volatility, and amount of use
- DPR also considered sampling and laboratory methods, and cost in selecting pesticides
- Pesticides divided into two groups for sampling and analysis: fumigants and all other pesticides



## Pesticides Monitored, continued

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- **Chloropicrin (fumigant)**
- Chlorothalonil (F)
- Chlorpyrifos, OA (I)
- Chlorthal-dimethyl (H)
- Cycloate (H)
- Diazinon, OA (I)
- Dicloran (F)
- Dicofol (I)
- Dimethoate, OA (I)
- EPTC (H)
- Ethalfluralin (H)
- Fonofos, OA (I)
- Iprodione (F)
- Malathion, OA (I)
- Mefenoxam (F)
- **Methyl Bromide (fumigant)**
- Metoalchlor (H)
- **MITC (fumigant)**
- Naled (I)
- Oxydemeton-methyl (I)
- PCNB (F)
- Permethrin (I)
- Propyzamide (H)
- Simazine (H)
- Trifluralin (H)
- Vinclozolin (F)



## Pesticides Not Monitored

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Battelle Memorial Institute, under contract to DPR, was unsuccessful in developing a laboratory method for the following pesticides:

- Acephate
- Anilazine
- Benomyl
- Dichlorvos (DDVP)
- Ethephon
- Maneb
- Methamidophos
- Methomyl
- Oxamyl
- Thiodicarb
- Thiophanate-methyl



## Methods – Monitoring Plan

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- Two monitoring plans, one for 3 fumigants and one for the 28 other pesticides
- Fumigant Monitoring Plan
  - Monitored large applications in close proximity to Lompoc (6 MITC, 2 methyl bromide/chloropicrin)
  - Collected alternating 8 and 16-hr samples for 72 hrs
  - Monitored 5 sites in Lompoc
  - Samples collected with sorbent tubes, and analyzed by Dept Health Services (MITC) and Dept Food and Agriculture (methyl bromide and chloropicrin)



# Methods – Monitoring Plan

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- Multiple Pesticides Monitoring Plan
  - 22 pesticides and 5 breakdown products monitored simultaneously
  - Collected 24-hr samples, 4 days/week, for 10 weeks (5/31/00 – 8/3/00); expected peak use period
  - Monitored 4 sites in Lompoc
  - Separate samples collected for oxydemeton-methyl for 2 weeks
  - Samples collected with sorbent tubes and analyzed by UC Davis



# Air Sampler

chloropicrin  
tube

methyl  
bromide  
tube



methyl  
bromide  
tube





# Air Sampler



chloropicrin  
tube

methyl  
bromide  
tube





## Methods – Quality Control

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- Quality control samples used to validate methods prior to study and check performance during study
- Validation ensured that detection limits were lower than health screening levels
- Duplicate field samples analyzed by second lab or method for confirmation
- A multi-agency group conducted several audits to ensure appropriate procedures were followed



## Methods – Weather and Pesticide Use

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- Weather
  - Portable weather station west of Lompoc measured wind speed, wind direction, temperature, humidity
  - APCD weather station at Central monitoring site
- Pesticide Use – DPR database of all agricultural pesticide applications includes:
  - Date applied
  - Amount applied
  - Application location
  - Crop and number of acres treated



# Health Evaluation Methods

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- DPR, with assistance from DHS and OEHHA, determined health screening levels
- Screening levels are based on a pesticide's toxicity. Concentrations below the screening level indicate a low health risk, but should not automatically be considered "safe." Conversely, concentrations above the screening level do not necessarily indicate a health concern, but a need for further evaluation.



## Health Evaluation Methods, continued

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- Screening levels determined from lab animal data and adding uncertainty factors to extrapolate from animals to humans
- When appropriate, an additional uncertainty factor included to address children's sensitivity
- Different time periods have different screening levels
  - Short-term (acute, 1 day)
  - Medium-term (subchronic, 3 – 14 days)
  - Long-term (chronic, 18 days – 10 weeks)



# Health Evaluation of Multiple Pesticides

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- Some pesticides exhibit toxic effects independently
- Some pesticides interact, with several possible modes of interaction
  - Additive: one chemical adds to the toxicity of another
  - Synergistic: one chemical multiplies the toxicity of another
  - Antagonistic: one chemical reduces the toxicity of another
- Example: organophosphates have a common mechanism of action and act in an additive manner
- For this study, DPR assumes that all monitored pesticides interact in an additive manner



# Health Evaluation of Multiple Pesticides

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- Risk from multiple pesticides (cumulative risk) evaluated using Hazard Quotient and Hazard Index
- Hazard Quotient gives risk estimate for *individual* pesticides

$$\frac{\text{Air Concentration Detected}}{\text{Screening Level}} = \text{Hazard Quotient}$$

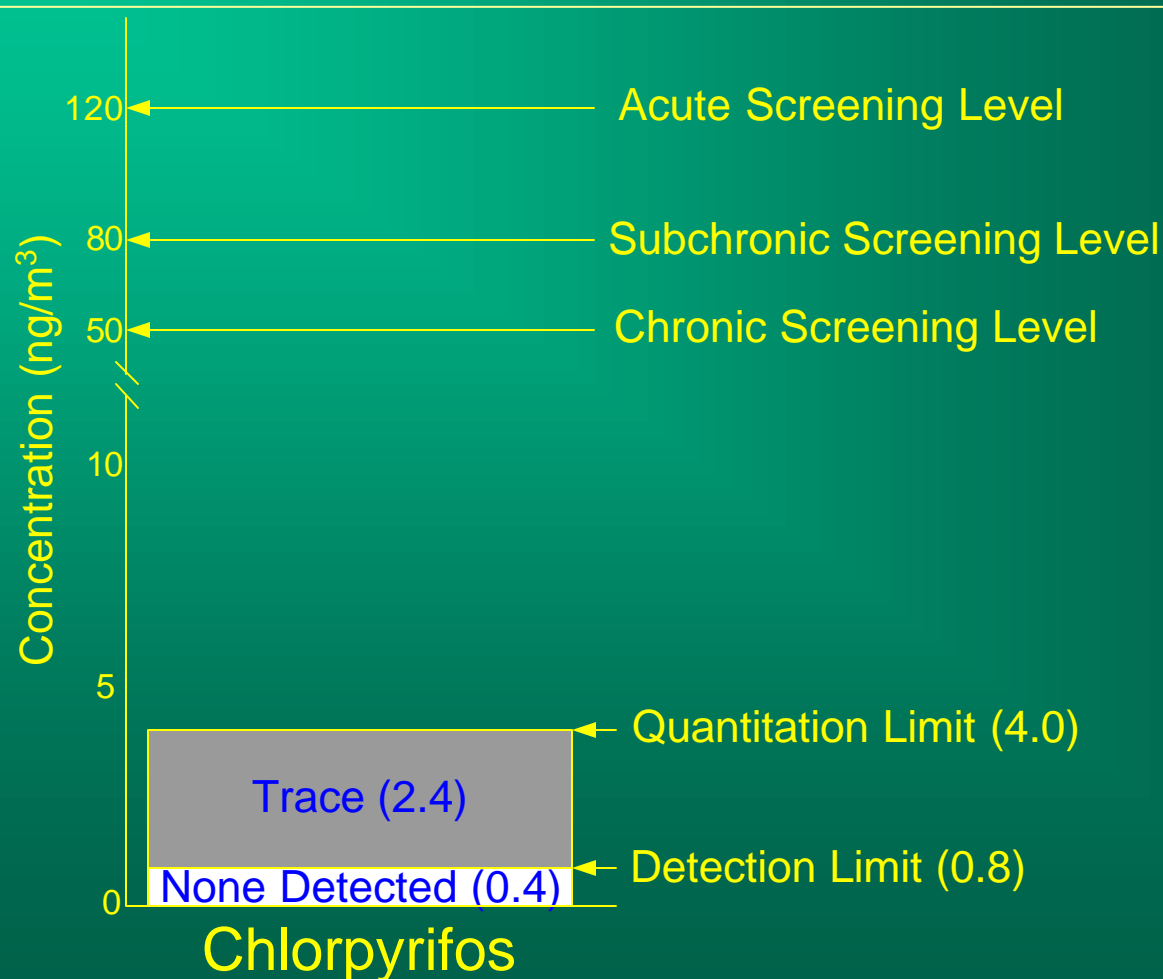
- Hazard Index gives risk estimate for *multiple* pesticides

$$\text{HQ of pesticide 1} + \text{HQ of pesticide 2} \dots = \text{Hazard Index}$$

- Hazard Quotients and Hazard Indices less than one indicate a low health risk



# Detection Limit vs. Screening Levels





# Results

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- Pesticides Detected
- Concentrations and Health Risk Estimates
- Results by Time and Location
- Weather and Pesticide Use Patterns
- Quality Control Results
- Comparison to Other Monitoring





# Pesticides Detected and Quantified

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- Chlorpyrifos
- Chlorpyrifos OA
- Chlorthal-dimethyl
- Cycloate
- Dicloran
- EPTC
- Malathion
- Malathion OA
- MITC
- PCNB
- Vinclozolin



## Pesticides Detected, Not Quantified

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- Chlorothalonil
- Diazinon (no use reported)
- Diazinon OA
- Dicofol (no use reported)
- Dimethoate
- Dimethoate OA
- Ethalfluralin (no use reported)
- Fonofos (no use reported)
- Iprodione
- Mefenoxam
- Methyl Bromide
- Metolachlor
- Naled
- Permethrin
- Propyzamide
- Trifluralin (no use reported)



## Pesticides Not Detected

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- Chloropicrin
- Fonofos OA (no use reported)
- Oxydemeton-methyl
- Simazine (no use reported)



## Highest 1-Day Concentrations

Pesticide	Concentration (ng/m <sup>3</sup> )	Acute Screening Level (ng/m <sup>3</sup> )	Adj Hazard Quotient
<b>MITC</b>	<b>1885 (16-hr)</b>	<b>66,000</b>	<b>0.02856</b>
PCNB	47.7	51,000	0.00935
Dicloran	17.6	850,000	0.00021
Vinclozolin	16.2	5,100	0.00318
<b>Chlorpyrifos</b>	<b>15.1</b>	<b>1,200</b>	<b>0.12615</b>
Chlorthal-dimethyl	14.2	3,400,000	0.00004
Cycloate	12.4	340,000	0.00036
Malathion	7.6	40,000	0.00019
<b>Chlorpyrifos OA</b>	<b>2.9</b>	<b>1,200</b>	<b>0.02379</b>
<b>Diazinon</b>	<b>Trace (2.1)</b>	<b>83</b>	<b>0.02530</b>
<b>Diazinon OA</b>	<b>Trace (1.6)</b>	<b>83</b>	<b>0.01930</b>



## Highest 14-Day Concentrations

Pesticide	Concentration (ng/m <sup>3</sup> )	Subchronic Screening Level (ng/m <sup>3</sup> )	Adj Hazard Quotient
<b>MITC</b>	<b>616 (3-day)</b>	<b>3,000</b>	<b>0.2050</b>
<b>PCNB</b>	<b>17.9</b>	<b>5,100</b>	<b>0.0350</b>
Dicloran	7.7	42,500	0.0018
Vinclozolin	4.9	51,000	0.0006
Chlorthal-dimethyl	4.4	17,000	0.0026
<b>Chlorpyrifos</b>	<b>4.0</b>	<b>850</b>	<b>0.0476</b>
Trifluralin	4.0	40,800	0.0010
<b>Cycloate</b>	<b>3.0</b>	<b>340</b>	<b>0.0359</b>
Diazinon	Trace (0.87)	83	0.0105
Diazinon OA	Trace (0.35)	83	0.0042



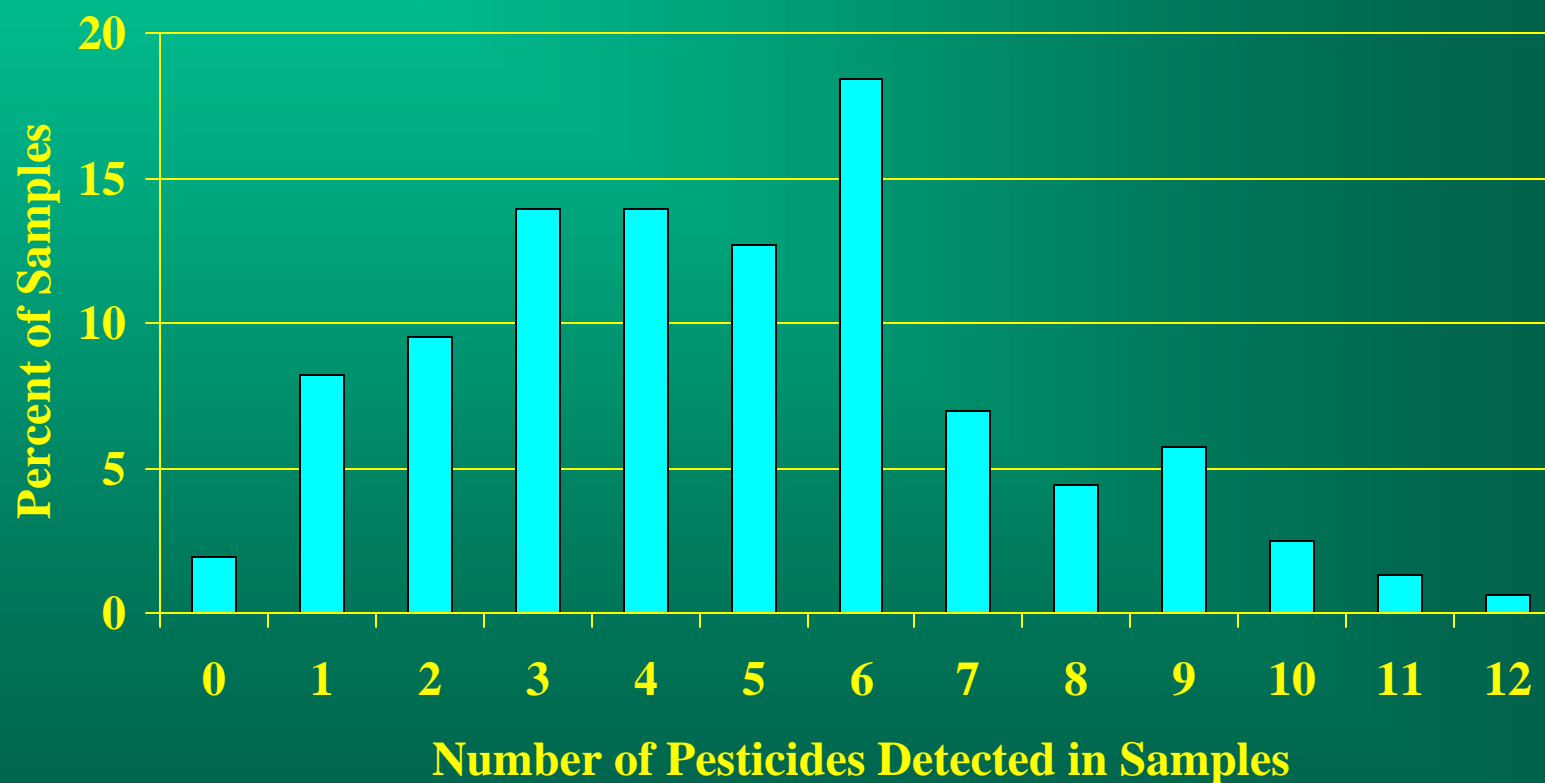
## Highest 10-Week Concentrations

Pesticide	Concentration (ng/m <sup>3</sup> )	Chronic Screening Level (ng/m <sup>3</sup> )	Adj Hazard Quotient
<b>MITC</b>	<b>244 (18-day)</b>	<b>300</b>	<b>0.8133</b>
<b>PCNB</b>	<b>8.5</b>	<b>5,100</b>	<b>0.0166</b>
Dicloran	3.1	42,500	0.0007
Chlorthal-dimethyl	2.1	17,000	0.0012
Vinclozolin	2.1	20,400	0.0009
Trifluralin	1.9	40,800	0.0005
<b>Chlorpyrifos</b>	<b>1.9</b>	<b>510</b>	<b>0.0374</b>
<b>Cycloate</b>	<b>1.6</b>	<b>340</b>	<b>0.0298</b>
Diazinon	Trace (0.54)	83	0.0065
Diazinon OA	Trace (0.29)	83	0.0035



# Samples With Multiple Detections

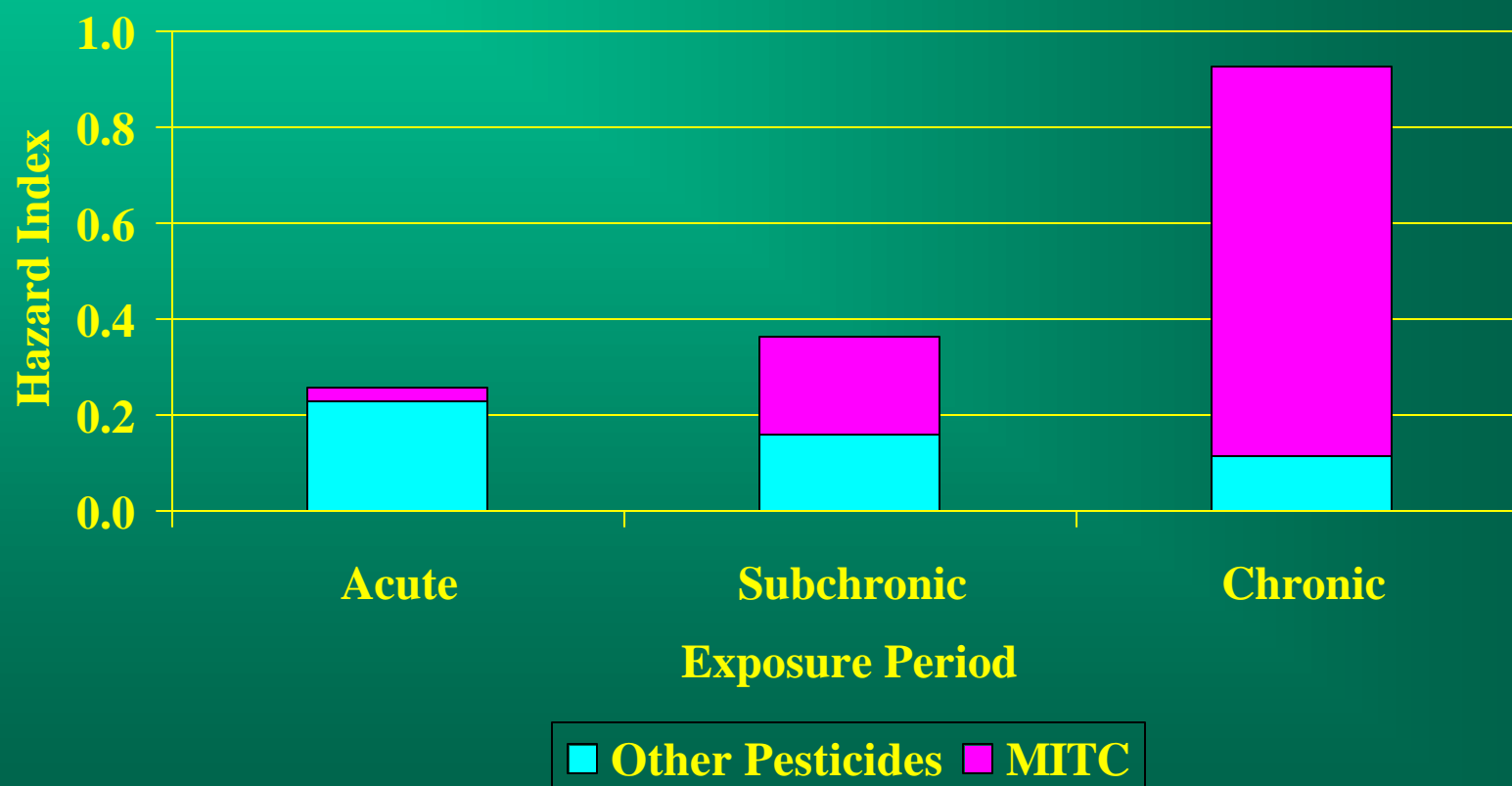
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# Risk From Multiple Pesticides

A hazard index less than one indicates a low health risk







# Risk From Multiple Pesticides

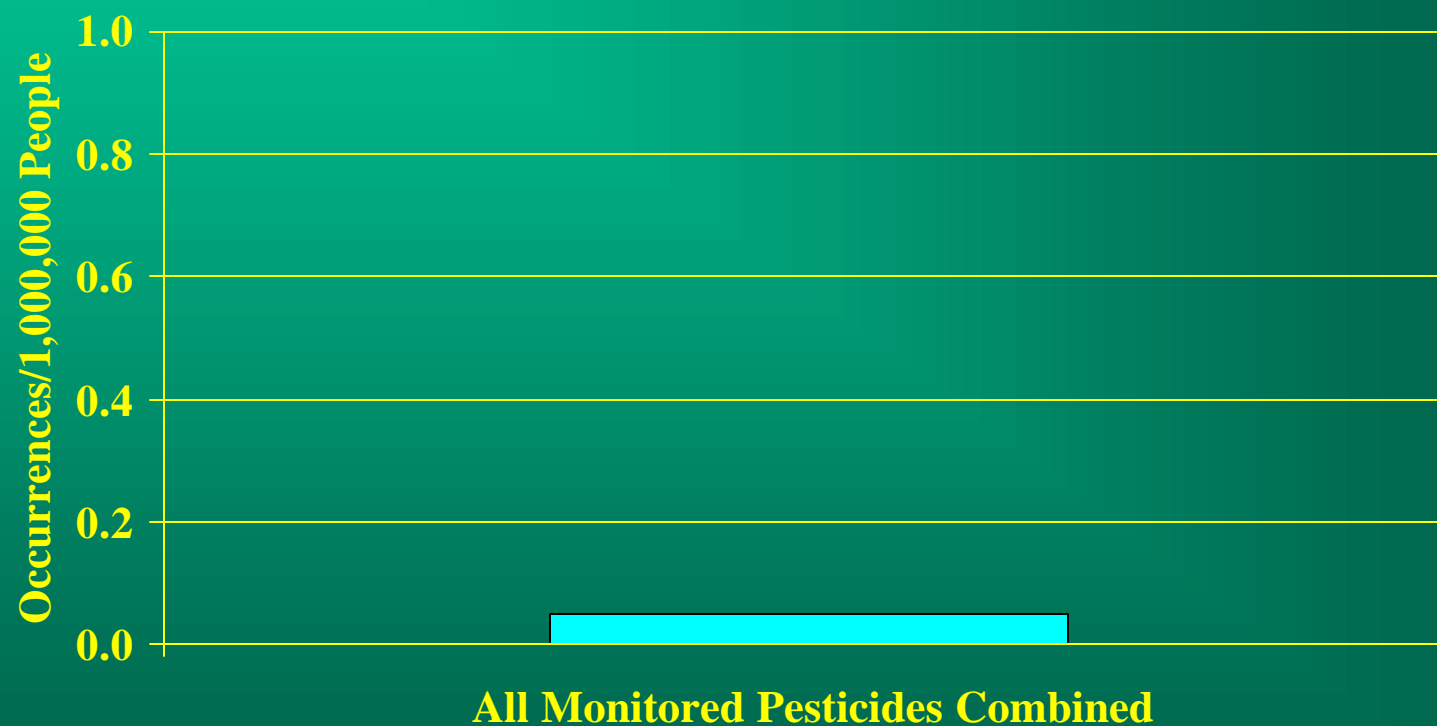
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- In relative terms, five pesticides accounted for more than 90% of the risk for all exposure periods
  - MITC (Metam, Vapam)
  - Chlorpyrifos and its oxygen analog (Dursban, Lorsban)
  - Diazinon and its oxygen analog
  - Cycloate (Ro-Neet)
  - PCNB (Terrachlor)



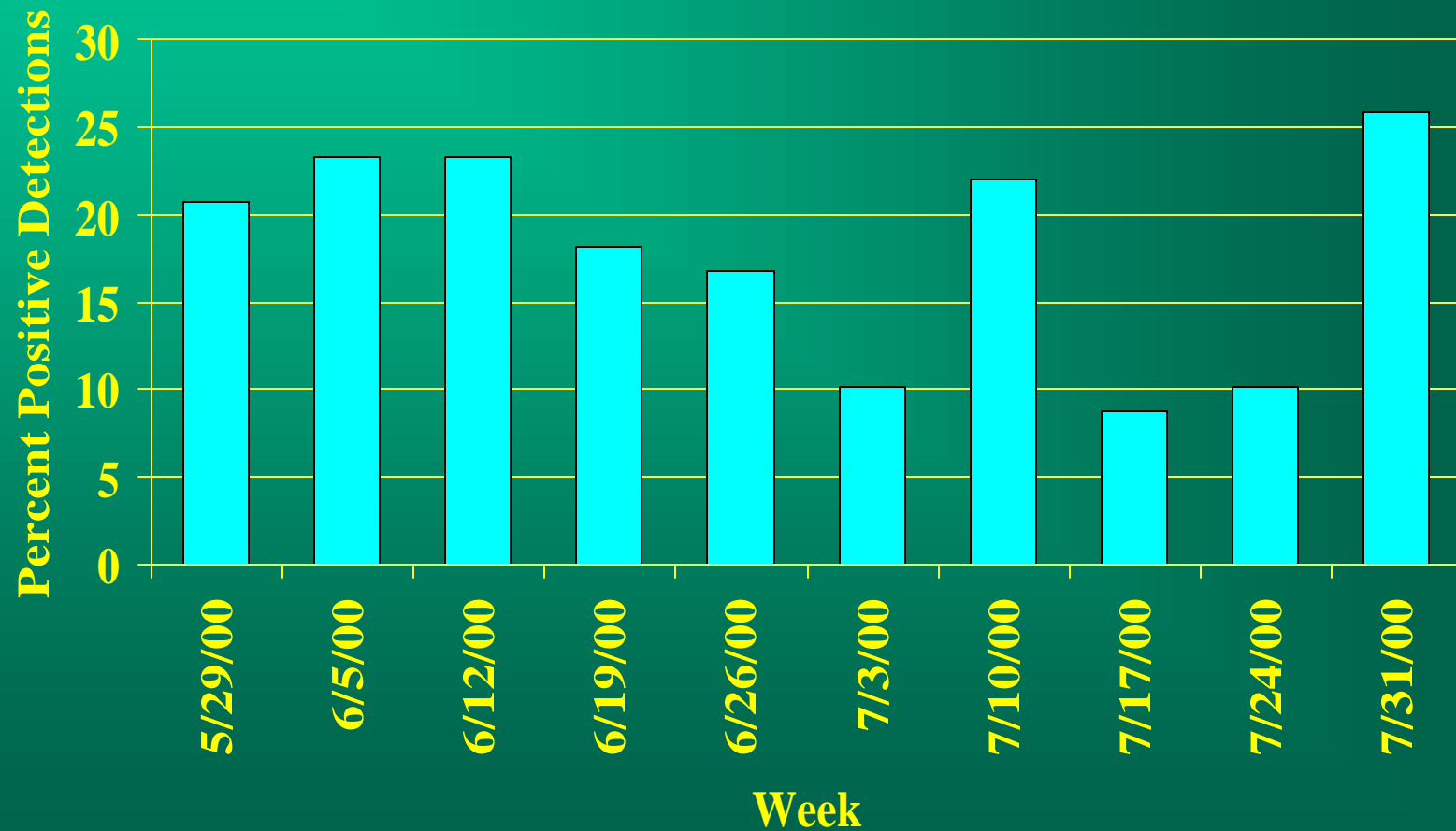
# Cancer Risk

Normal benchmark for negligible risk is 1 cancer per 1,000,000 people





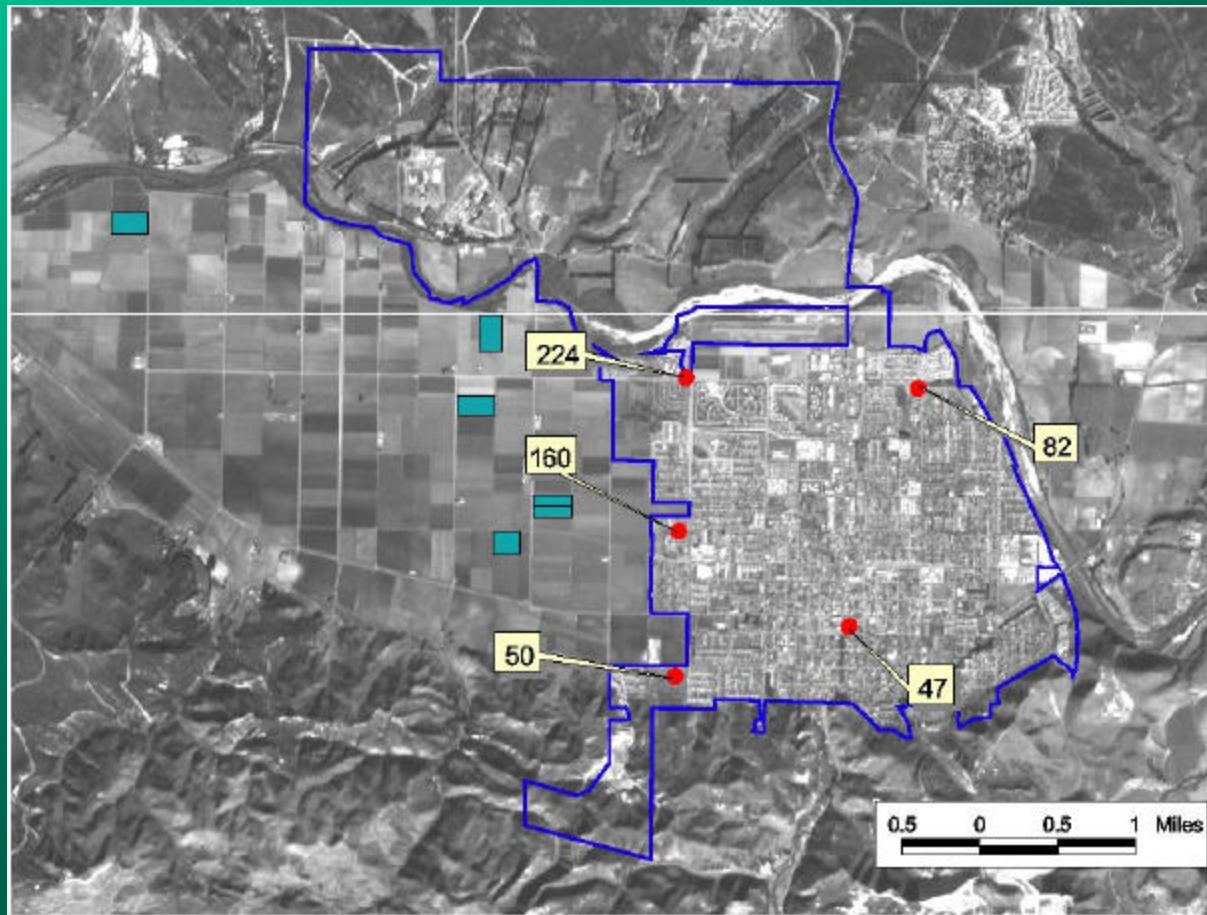
## Results Over Time (fumigants excluded)





# Results by Location (MITC)

Average concentration (ng/m<sup>3</sup>) for six MITC applications

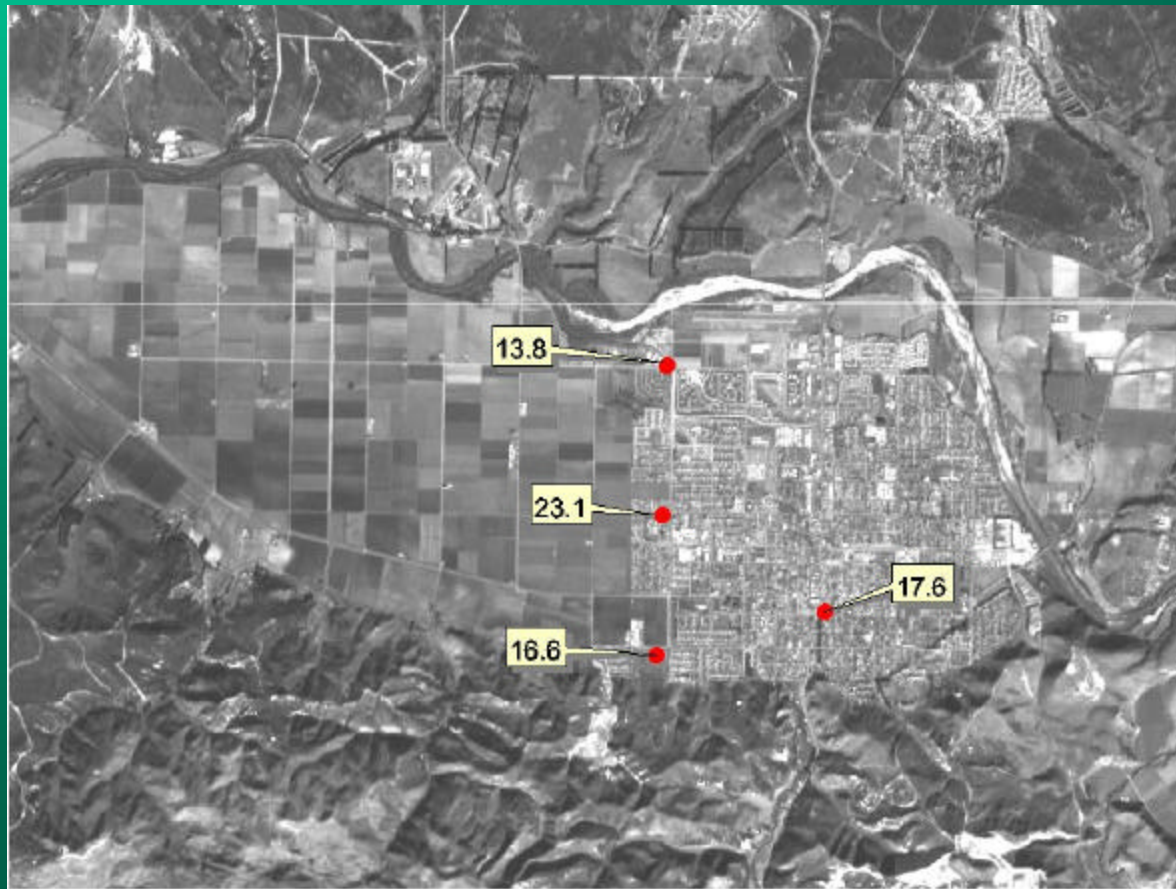




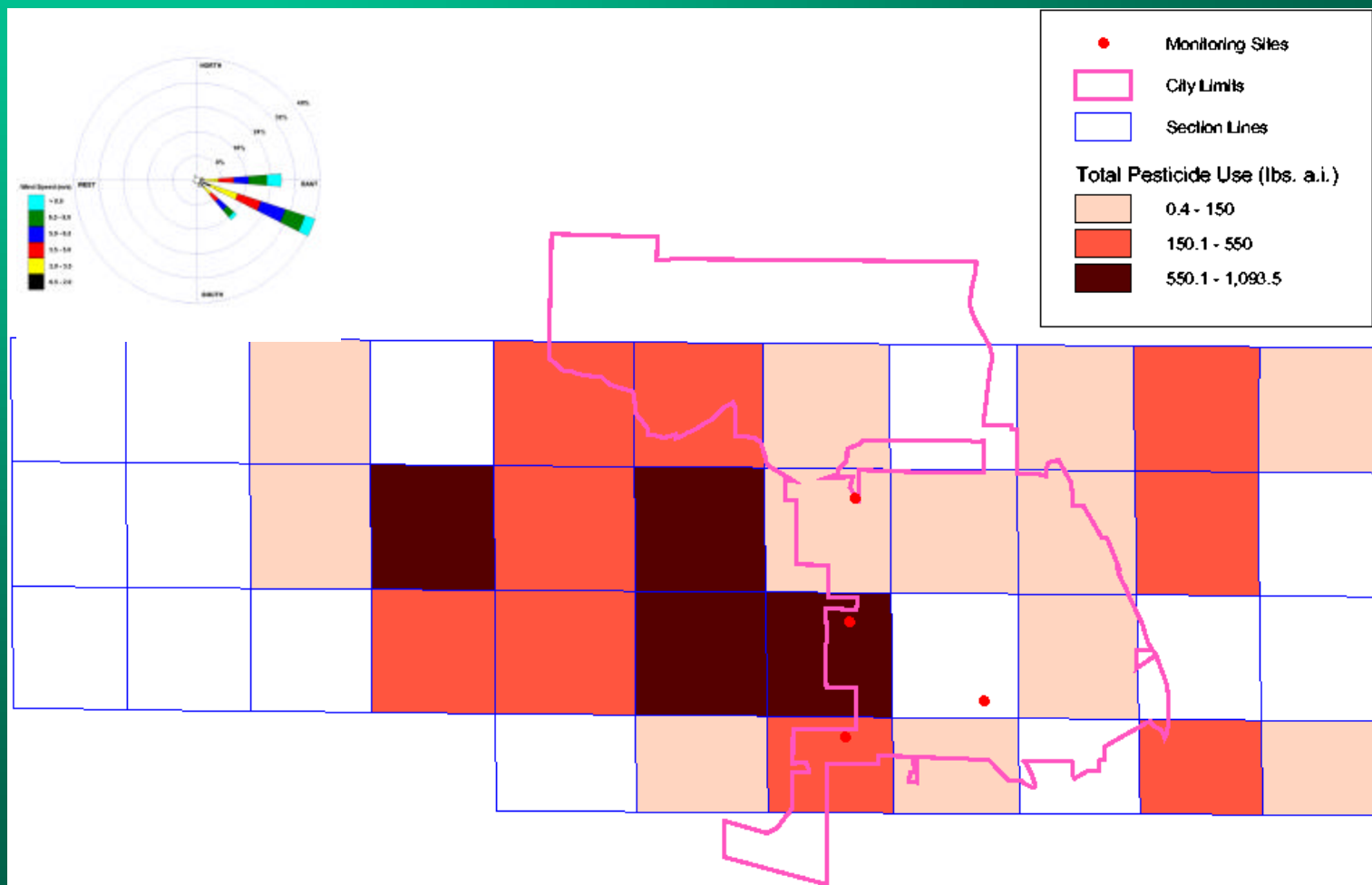
## Results by Location (fumigants excluded)

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Percent positive detections



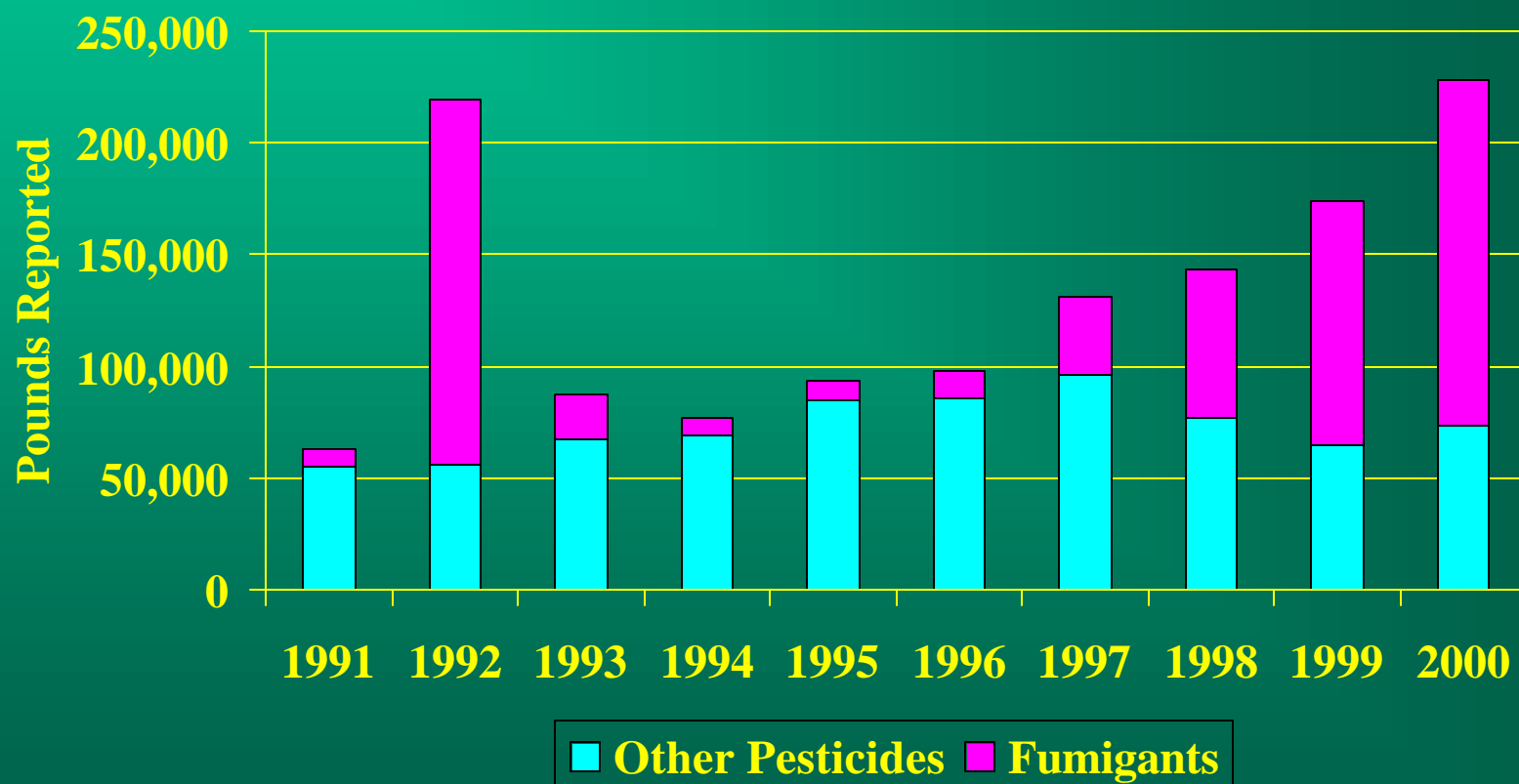
# Weather and Use Patterns (fumigants excluded)





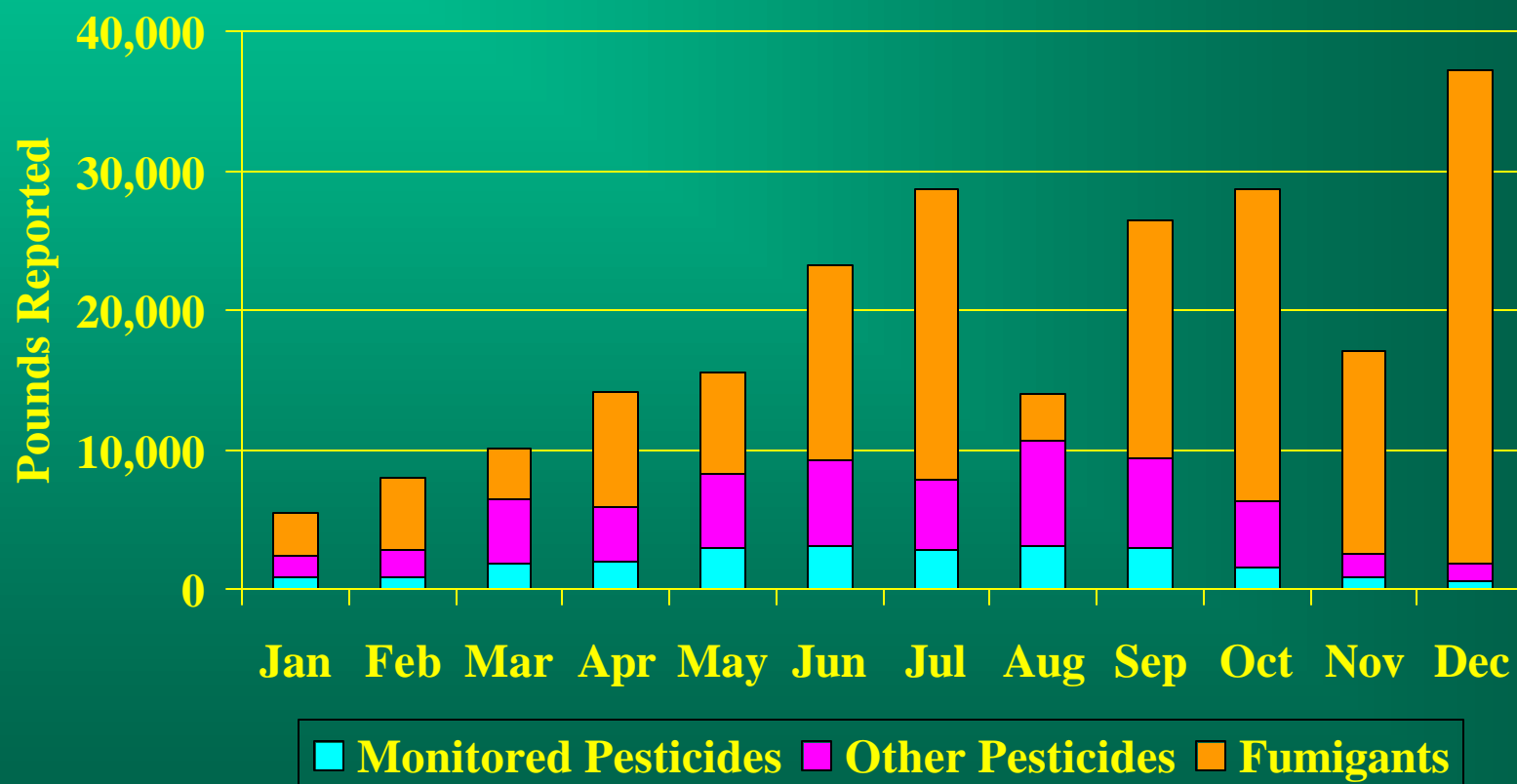
# Yearly Pesticide Use

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# Monthly Pesticide Use (2000)







## Concentrations During Periods Not Monitored

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- It was not possible to estimate air concentrations for time periods and locations not monitored using computer modeling or statistical techniques
- Pesticide use patterns may give an indication of possible concentrations for periods not monitored
  - Daily use may give an indication of acute exposure
  - Monthly use may give an indication of subchronic and chronic exposure



## Highest Daily Pesticide Use

Pesticide	Highest Daily Amt During Monitoring (lbs)	Highest Daily Amt During 2000 (lbs)	Ratio of 2000/Monitoring Period
Cycloate	4.5	16.7	3.7
Chlorothalonil	36.3	89.1	2.4
Iprodione	49.3	119.2	2.4
Vinclozolin	34.8	75.0	2.1
Permethrin	17.8	35.0	2.0
<i>All Monitored</i>	<i>294</i>	<i>361</i>	<i>1.2</i>

Diazinon, ethalfluralin, and trifluralin were used during 2000, but not reported during the monitoring period. Ratio of all other pesticides was less than 2.0.



## Highest Monthly Pesticide Use

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- Monthly use of cycloate was 2.3x higher in November than the monitoring months (Jun – Jul)
- Monthly use of all other pesticides was less than 2x higher in months not monitored
- June was the highest month for all monitored pesticides combined in 2000
- Diazinon, ethalfluralin, and trifluralin were used during 2000, but not reported during the monitoring period



## Quality Control Results

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- None of the blanks were positive, indicating no inadvertent contamination
- Analysis of samples with known amounts (spikes) recovered 70 – 120% except: chlorpyrifos oxygen analog, cycloate, EPTC, ethalfluralin, and MITC
- MITC confirmation samples (canisters) had higher concentrations than primary samples (sorbent tubes)
- MITC concentrations adjusted for low recovery
- Others not adjusted because the effect on the hazard quotients is negligible
- Audits showed no major problems



## Comparison to Other Monitoring

Pesticide	Max 24-hr Concentration (ng/m <sup>3</sup> )	Lompoc Max 24-hr Concentration (ng/m <sup>3</sup> )
Chlorothalonil	4.6	Trace (<7)
Chlorpyrifos	815	83
Diazinon	290	18
EPTC	240	6.5
Malathion	90	7.6
Methyl Bromide	142,000	Trace (<4000)
MITC	18,000	677
Naled	65	Trace (<5)
Oxydemeton-methyl	ND (<12)	ND (<0.9)
Permethrin	Trace (<15)	Trace (<7)
Simazine	18	ND (<0.6)



## Conclusions & Recommendations

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- Air concentrations were less than screening levels, indicating low risk from monitored pesticides
- Estimating risk of methyl bromide and chloropicrin is difficult because applications occur downwind (east) of Lompoc
- Weather and pesticide use during most monitoring were consistent with historical patterns
- Some pesticides may have higher concentrations than measured because some pesticides had other days or months with higher amounts applied



## Conclusions & Recommendations, continued

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- This study likely documents the upper end of the cumulative or combined risk of all monitored pesticides for 2000
- As with all scientific studies, these risk estimates have uncertainties
  - Lack of information for some effects such as hormone and immune disruption
  - Unknown interactions between some pesticides
  - Lack of information for pesticides not monitored
  - Unknown exposure from ingestion or skin absorption



## Conclusions & Recommendations, continued

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- Only MITC had measured air concentrations that approach its screening levels
  - MITC concentrations exceed the screening level in other areas of the state
  - DPR is developing statewide regulatory measures to reduce MITC exposure





## Questions/Additional Information

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